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Polyvinyl Chloride (PVC): It's Hard to Imagine Life Without It

February 2004

PVC is used to make...

- ✓ adhesives
- ✓ artificial limbs
- ✓ auto parts
- ✓ baby bibs
- ✓ baby strollers
- ✓ backyard furniture
- ✓ belts
- ✓ bicycle seats
- ✓ bonding agents
- ✓ camera cases
- ✓ card tables and chairs
- ✓ computer parts
- ✓ car bumper pads
- ✓ decks
- ✓ door frames
- ✓ electrical insulation
- ✓ exercise equipment
- ✓ fences
- ✓ film
- ✓ floor mats
- ✓ food containers
- ✓ food wrappings
- ✓ garden hoses
- ✓ golf bags
- ✓ gutters
- ✓ gutter leaf guards
- ✓ handbags
- ✓ inflatable boats
- ✓ IV bags and tubing



Society has found hundreds of uses for polyvinyl chloride, the plastic referred to simply as "vinyl" or "PVC." Chances are you have some contact with at least one PVC item every day. Doubtful? Take a look at the yellow checklist of PVC-containing products.

While most plastics are made mostly of petroleum (yes—petroleum—it's true!), only 40 percent of the PVC molecule comes from petroleum; 60 percent of it is chlorine, from salt, NaCl. Chlorine gives PVC useful properties like fire-resistance and durability.

PVC is a thermoplastic—a substance that loses its shape when heated, and then becomes rigid again as it cools. Heat can help shape PVC into countless useful forms. In fact, its thermoplastic properties make recycling PVC relatively easy because, with heat, this material can be reshaped for new uses. PVC and polyethylene, another plastic, are the most widely used of all thermoplastics.



Substituting for Rubber.

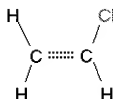
Rubber, a natural waterproof product made from the sap of the tropical Hevea tree, was in short supply during World War II. Scientists considered their choices for a rubber substitute and settled on a synthetic material developed in a German laboratory in the 1920's—PVC. The compound had been made by reacting natural materials (petroleum products and chlorine) together. The new substance was waterproof, durable and a good insulator. Among other things, PVC began to replace rubber as an electrical wire insulator on board ships. Because the addition of chlorine adds flame-retardant properties to PVC, vinyl wire insulation proved to be even safer than the original rubber insulation. PVC has been used as an electrical wire insulator since World War II, helping deliver electricity safely.



More and more uses for PVC have been developed over the years—the checklist on these pages indicates the great variety of products manufactured with this material. PVC

- ✓ molding strips
- ✓ plumbing fittings
- ✓ raincoats and boots
- ✓ roofing tiles
- ✓ school and office supplies
- ✓ seat coverings
- ✓ sheeting
- ✓ shoes
- ✓ shower curtains
- ✓ siding
- ✓ swimming pool liners and covers
- ✓ textile coatings
- ✓ toys
- ✓ trellises
- ✓ umbrellas
- ✓ upholstery
- ✓ wall coverings
- ✓ wallets
- ✓ watch straps
- ✓ water floats
- ✓ water pipes
- ✓ window frames
- ... and more

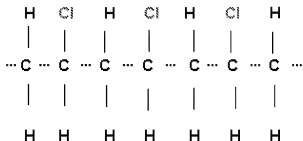
gobs of spaghetti. They are made by chemically linking together many similar smaller units, known as monomers. Vinyl chloride (C_2H_3Cl) is the monomer link in the polyvinyl chloride chain. Vinyl chloride may be represented by the structural formula:



Atom Legend

C = Carbon
H = Hydrogen
Cl = Chlorine

Any small section of the polymer looks like this:



Notice that the links between carbon atoms has changed from double-links in the monomer to single-links in the polymer. Single- and double-links represent different types of chemical bonds between atoms. PVC polymer is a fine white powder, or resin, known as vinyl resin. This resin is treated with various additives and modifiers to make the two main types of vinyl.

PVC : Rigid or Flexible--Most Versatile!

PVC may be manufactured to be either rigid or flexible. Rigid PVC is used to make construction materials such as home siding and pipes. More than 70 percent of all the PVC made in the U.S. is used in construction. It's no wonder the demand for PVC is a good indicator of the health of a nation's economy.



Flexible PVC, used to make raincoats and shower curtains, for example, is manufactured using compounds known as plasticizers, which make the material soft and flexible.

PVC Improves Life Around the World

PVC pipes have replaced millions of miles of old metal pipes that for years carried clean water into homes and wastewater away. PVC pipes have a big advantage over metal pipes in that they require very little maintenance—they don't rust and corrode and develop slimy coatings where bacteria may grow. Compared to metal pipes, PVC pipes are inexpensive and lightweight (so transporting them is not too costly).

affordable. In addition, The Chlorine Chemistry Council's Water Relief Network® and its partners donate money and chlorine products like PVC and chlorine drinking water disinfectants to help these communities obtain "safe water, delivered safely."



Installing PVC water pipes in a village in Honduras



PVC has an important role in health care. Medical blood and intravenous bags and tubing are made of flexible PVC, the ideal material for safely storing and delivering life-giving blood, nutrients and medicines to the sick and injured.

Like the monomers in the PVC polymer chain, the good uses that PVC have been put to go on and on...

Follow-Up Activities

1. Keep a diary of the PVC items that you use or depend upon for one entire day. Make separate lists of rigid and flexible PVC.
2. Silk and DNA are examples of natural polymers. Can you name any others?
3. Using atomic masses of carbon, hydrogen and chlorine found on the Periodic Table of the Elements, calculate the atomic mass of the vinyl chloride monomer. What is weight percent of carbon in the monomer? Of hydrogen? Of chlorine?

For a list of previous "Chlorine Compound of the Month" features, click here

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